PLATE XXIX.

Herpetocypris chevreuxii.

Figs. 1, 2. Shell seen laterally and dorsally, × 20.
3. Posterior antenna, × 84.
4. ,, maxilla, × 84.
5. Tooth of anterior maxilla, × 300.
6. End of foot of second pair, × 240.
7. Caudal ramus, × 120.
7*a*. Marginal spines of same, × 240.

Ilyodromus olivaceus.

Fig. 8. Posterior antenna, × 120.
9. Foot of first pair, × 84.
10. ,, second pair, end, × 240.
11. Caudal ramus, × 84.

Ilyodromus robertsoni.

Fig. 12. Posterior maxilla, × 200.

PLATE XXX.

Fig. 1. Shell of *Candona angulata* with encysted trematodes.
2–4. Cysts of the above in various stages of development.
5. *Neorhynchus* (? *claviceps* Zad.).

P. Proboscis. *L.* Lemnisci. *S.C.L.* Subcuticular layer. *R.* Retractor of proboscis. *G.N.* Giant nucleus. *T.* Testis. *V.D.* Vas deferens. *G.* Glands. *G.P.* Genital pore.

5. A Contribution to the Anatomy of *Hippopotamus amphibius*. By FRANK E. BEDDARD, M.A., F.R.S., F.Z.S., Prosector to the Society.

[Received January 18, 1910.]

(Text-figures 22–25.)

Our knowledge of the anatomy of this animal so far as the viscera are concerned is due principally to the great work of Gratiolet *, and to shorter and more recent memoirs by Crisp †, Clark ‡, Garrod §, Flower ‖, Alix ¶, Chapman **, Weber ††, Peters ‡‡, as well as to Dr. Macalister's §§ memoir upon the Liberian Hippopotamus.

* Recherches sur l'Anatomie de l'Hippopotame. Ed. by Alix. Paris, 1867.

† "On some Points connected with the Anatomy of the Hippopotamus," P. Z. S. 1867, p. 601.

‡ "Notes on the Visceral Anatomy of the Hippopotamus," P. Z. S. 1872, p. 185.

§ "On the Brain and other parts of the Hippopotamus," Trans. Zool. Soc. xi. p. 11.

‖ "Lectures on the Digestive Organs of Mammals," Med. Times & Gazette, 1872.

¶ "Sur la Glande lacrymale de l'Hippopotame," Bull. Soc. Philom. Paris (7) iii. 1879, p. 146. "Sur le Plexus cervicale," *ib.* p. 167. "Sur le Glande Sympathique de l'Hippopotame," *ib.* p. 168. "Sur la Glande lacrymale de l'Hippopotame," Bull. Soc. Zool. Fr. iv. 1879, p. 117.

** "Observations upon the Hippopotamus," P. Acad. Philad. 1881, p. 126.

†† Studien über Säugethiere: i. Beiträge zur Anatomie von *Hippopotamus amphibius*. Jena, 1886.

‡‡ In 'Reise nach Mossambique,' Saügethiere, 1852, p. 180.

§§ "The Anatomy of *Chœropus liberiensis*," P. Roy. Irish Acad. (2) i. 1874, p. 496.

These numerous memoirs between them deal with all the organs of the body. The recent dissection of a male specimen which died in the Society's Gardens has enabled me to verify a number of the recorded facts, and also to add some few details to our knowledge of the anatomy of the Hippopotamus. In particular, I believe that I am able to compare more satisfactorily than has yet been done the intestinal tract of this animal with that of its allies.

When the animal is cut open the stomach is seen to occupy the greater part of the abdominal cavity; it completely hides the liver, which is behind it. A transversely running section of the colon is nearly all that is visible of that gut, and it lies between sections of the small intestine. The only part of the gut upon which I made observations worth recording as a contribution to our knowledge of the anatomy of this animal, was the colon. Of this section of the gut Gratiolet* wrote: "Le côlon ascendant décrit une ligne sineueuse dans laquelle en peut compter six anses successives. Il y a ensuite un côlon transverse, une S iliaque médiocrement courbée, placée très-près de la ligne médiane, et enfin un rectum très-musculeux." This description is not in the present state of our knowledge of the mammalian gut enough to indicate the relationships with other Artiodactyles. Dr. Crisp figures the entire alimentary canal of this Pachyderm, but gives so generalised a figure that no details can be ascertained beyond the well-known absence of cæcum, and the proportions, roughly speaking, between the long small and the short large intestine.

The figure of Gratiolet is better, and represents some of the essential features of this gut in the Hippopotamus as I would interpret them. The six successive loops of the colon are given in his illustration, and then the sharp bend backwards to form the straight running descending colon and rectum. According to Flower, "The colon is comparatively short, about one-tenth of the whole intestine, and instead of the spiral convolution found in most Artiodactyles, its first or ascending part is thrown into about six transverse folds, and then it pursues the usual course of the transverse and descending colon." This description agrees entirely with the figure of Gratiolet. There are, as I believe, no further notes upon the alimentary canal of the Hippopotamus tending to explain its relations to and differences from the alimentary canal of other Artiodactyles, save a brief reference by Dr. Mitchell in his comparative survey of the Mammalian gut †. The colon of the example of *Hippopotamus* which I have myself examined appeared to be like that of other examples; but my own observations enable me to add some details which serve to fix more plainly, as I think, the correspondence between the colon of this animal and that of others among its allies. It is to be noted, in the first place, that the colon has, to begin with, a

* *Loc. cit.* p. 395.
† Trans. Zool. Soc. vol. xvii.

descending direction. Its origin from the small intestine—though, as is well known, there is no cæcum—is quite marked, and cannot be missed. This descending origin is decidedly on the left side of the body, the origin of the duodenum on the right side really occupying the position so often seen in mammals to be occupied by the cæcum. The first part of the colon is quite loosely arranged, and although six tolerably regular folds are figured by Gratiolet, it must not be inferred from the stress laid upon these folds by him and by Flower, that they are definite entities. On the contrary, the colon is in this region entirely lax and can be passed through the fingers in a perfectly straight line without in the least damaging the mesocolon by which it is suspended. There is, in fact, no really definite series of colic loops. The colon happens to lie in this way or that to meet the conditions of space; but it is as free from any ansæ coli as is that of the Primates or the Marsupialia, &c.

We have to note therefore, in the first place, that *Hippopotamus* in the arrangement of the gut is more primitive than is any other Artiodactyle, or indeed than any other Ungulate, excepting perhaps the Elephant. In surveying the various Orders of Mammals with reference to the coiling of the gut *, I was unable to find any Artiodactyle which had not a very specialised gut. Even *Tragulus*, which lies near to the base of the series, so far as living Artiodactyles are concerned, showed all the typical artiodactyle features in the arrangement of its colon and in the permanent loops thereof. The animal therefore furnishes additional evidence in favour of the contention that the gut undergoes an evolution in separate groups, the stages being in all cases the same in general outline. A knowledge of the intestinal tract of the Hippopotamus thus fills a very considerable hiatus in what is known concerning the group of Artiodactyles.

It is, however, important to notice that while the gut of the Hippopotamus represents Stage II. among the Artiodactyles †, a stage which has been hitherto missing in that group, there is not a precise correspondence between the gut and that of, for example, a Kangaroo which represents the same stage. The intestinal tract of *Hippopotamus* is distinctively Artiodactyle, or at least Ungulate, in various features to which I now shall direct attention. In the first place, the position of the vanished cæcum is on the left side of the body, and the colon therefore commences by passing in a downward direction. This is precisely what we find in other Ungulates, for example in *Hyrax* ‡. The second feature of importance in which the gut shows an Ungulate, and this time a distinctively Artiodactyle, character, is in the

* "On the Anatomy of *Antechinomys*, &c.," P. Z. S. 1908, p. 561.

† I am not absolutely certain whether the gut of *Hippopotamus* may not really belong to Stage I. Gratiolet speaks of a continuous mesentery for both small and large intestine. Unfortunately my own notes are defective as to this point.

‡ See Beddard, "On the Anatomy of *Antechinomys*, &c.," P. Z. S. 1908, p. 582, fig. 115.

sharp turn of the ascending to form the descending colon. This is particularly well seen in, for instance, *Tragulus*. But it occurs in other Artiodactyles also.

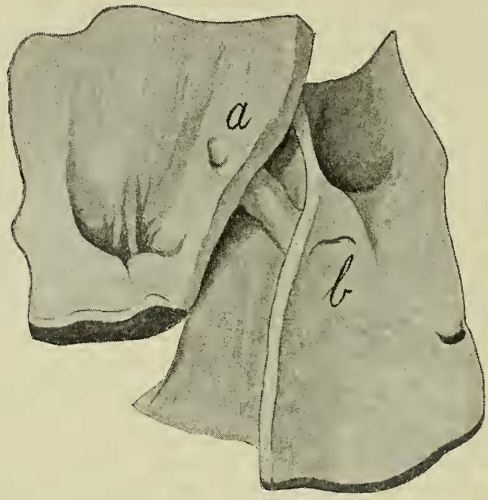
The enormous stomach of the Hippopotamus has been described by so many writers, indeed by all those quoted above as well as by some earlier contributors to our knowledge of this "Pachyderm," such as Daubenton. The various chambers of the stomach seem to be now well understood, and in consequence I have not troubled myself to revise the existing knowledge upon this subject. But one matter which I noted in connection with that organ has not been dwelt upon by previous writers. If it has been noted at all, it has escaped my attention. I found in the case of the young animal which I examined, that along a line parallel with the elongated spleen and about coextensive with that organ, the stomach was attached to the ventral parietes by a strong white band of connective tissue. The direction of this was rather obliquely longitudinal, being somewhat between the transverse and the longitudinal planes of the body. On the opposite side of the body the stomach was attached to the dorsal parietes by an equally strong ligament. This latter may, of course, be regarded as the mesogaster. But the homologies of the ventral ligament are not so clear.

I showed the structure to my colleague Dr. Plimmer, who was of opinion that the ligamentous band was not a pathological structure, and indeed it hardly gave the impression of being of that nature. It may perhaps be regarded as representing a portion of the ventral mesentery, of which in other mammals the falciform ligament is the only representative. In the case of the Hippopotamus, however, the direction of this ligament was not quite such as to lead to a confident assertion of this view of its homology. The attachment of the stomach to the ventral parietes is, I believe, a new structural feature for a mammal. It obviously reveals the conditions which obtain in the Crocodilia (and in Birds). The fixation of so huge an organ as is the stomach of this great beast when distended with food would seem to be a most useful fact in its economy, and it is possibly to be looked upon in this light. For one can hardly make the comparison suggested with the aquatic Crocodilia save as due to a like need.

The *heart* in the example which I have studied does not show any marked bifidity of its apex such as has been described in this animal. Indeed nothing of the kind was obvious to me. As Gratiolet has observed, there are no corpora Arantii in the valves of the pulmonary artery. These nodules are also absent from the same valves in the Peccary. The accompanying drawing (text-fig. 22, p. 224) illustrates the interior of the aorta and pulmonary artery, and shows the crescentic depression in each which represents the former orifice of the ductus Botalli. It will be noted that, in accordance with the direction of the tube (which is a solid band in the adult and indicated in the figures already

referred to), the rudimentary orifice is thickened along one side; *b* is the aortic orifice, *a* that in the pulmonary artery.

Text-fig. 22.



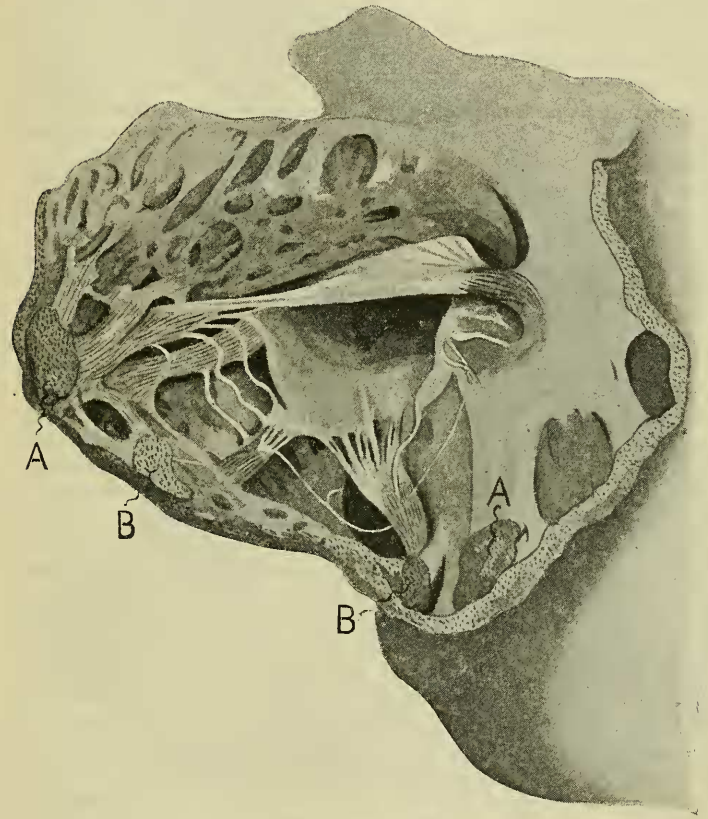
The aorta and pulmonary artery of *Hippopotamus* opened up to show the vestigial orifices (*a* & *b*) of the ductus Botalli.

The *right ventricle* fully opened is shown in text-fig. 23. It will be observed from the very accurate figure that the free wall of that ventricle is not sculptured into columnæ carnosæ, but merely presents an honeycombed appearance. It is in fact only unevenly pitted with variously sized excavations which acquire, near to the attached wall of the ventricle, some approach to the more usual arrangement of trabeculæ. The auriculo-ventricular valve itself was markedly tricuspid, and it is shown in the text-figure not in its normal position. For the cutting and reflection of the free wall of the ventricle has carried with it the muscles attached to the middle flap of the valve, the infundibular cusp of human anatomy. On the extreme left the valve is attached to the septal wall of the ventricle in a way which is not universal among Mammals. There is, in fact, a thick and well-marked papillary muscle in this situation which is shown in the figure, as are the other papillary muscles, as striated longitudinally, to distinguish them more definitely from the walls of the ventricle. This septal papillary muscle is quite short and very stout.

The anterior papillary muscle is rather complex. Its actual origin from the ventricular wall is marked by the letter "A" towards the right of the drawing (text-fig. 23), and a portion of it also arises from the neighbouring cut edge marked "B." The actual course of the papillary muscle and its subdivisions is

shown on the left of the drawing with the same letters attached to the corresponding parts. It will be noticed that this, the anterior or great papillary muscle, arises very near to the junction between the free and the septal wall of the ventricle. The septal half of the auriculo-ventricular valve arises from or is connected with two perfectly distinct papillary muscles, of which the left-

Text-fig. 23.



Interior of right ventricle of *Hippopotamus*.

AA, BB. Attachments of great papillary muscle.

hand one (that to the right in the figure) is the larger. From the cut edge "A" to the left of the figure a muscle passing upwards is seen. This I regard as the moderator band. An interesting feature of this heart consists in the presence of chordæ tendineæ, which run parallel with the margin of the auriculo-

ventricular valve and connect the successive papillary muscles. The arrangement of these is such as to suggest a former great extension of the membranous valve towards the apex of the ventricles.

It seems to me from the account given by Gratiolet * of this valve, that in the specimen which he dissected the papillary muscles of the septal half of the valve were not much developed. Otherwise there is no great difference between his account and that given above, save that I have entered into the matter somewhat more in detail.

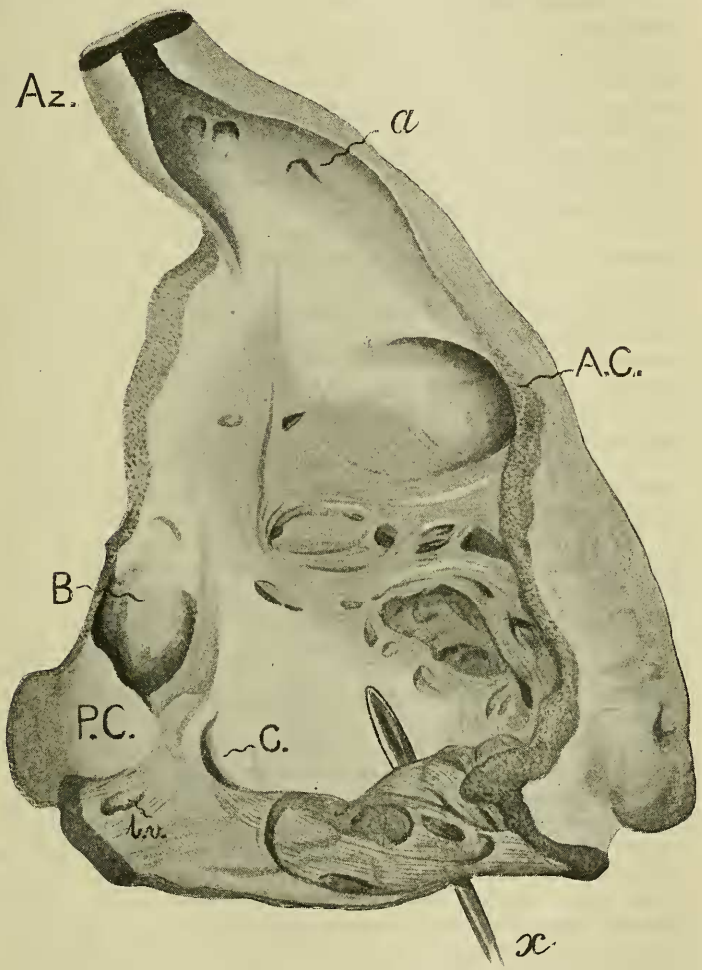
Dr. Crisp, in his account of the Hippopotamus, remarks of the right auriculo-ventricular valve that the "tendons of the Tricuspid valve, seventeen in number, spring from three columns (so-called), one prominent and nipple-like, the others but little raised above the surface." I fancy from this account that the specimen examined by that anatomist was not unlike the one described by myself in the present communication. My figure shows a number of chordæ tendineæ which is not very far from the number asserted by Dr. Crisp, while his description of the musculi papillares, although not absolutely agreeing with the arrangement of those muscles as I saw it, emphasizes, as I think, the stout elevated muscle to the extreme right of the ventricular cavity in the figure.

The accompanying figure (text-fig. 24) represents the interior of the *right auricle* of the Hippopotamus, which has never been figured so far as I am aware, though many of the features there visible are referred to by previous writers. The auricular appendix, shown to the right of the drawing, is not completely opened up. A seeker is shown passing through the auriculo-ventricular orifice and appearing below, the ventricle being supposed to be completely removed. This will serve to orient the various parts of the auricle. Those parts of the auricle where the endocardium is very thin so as to expose the musculature, are represented as striated to emphasize this muscular appearance. On the right upper side of the drawing is seen the precaval vein (A.C.), which debouches very close to the orifice of the azygos (Az.). The arrangement is, in fact, exactly that of the Peccary (*Dicotyles torquatus*), of which animal I dissected a heart for the purposes of comparison with that of *Hippopotamus*. The circumference of the mouth of the azygos is 46 mm., while that of the precaval I calculate to be fully 60 mm. It is obvious, however, that the azygos is relatively very large. It has been already observed that the postcaval vein is very small where it debouches into the auricle. This is certainly the case in the heart which I examined and as is shown in the drawing (text-fig. 24, P.C.). I find on reference to the heart of the Peccary, that the conditions observable in the Hippopotamus are only an exaggeration of what is to be seen in the former animal. In the Peccary the postcaval is

* *Loc. cit.* p. 358.

distinctly smaller than the precaval. In the Hippopotamus' heart the postcaval had unfortunately been cut away very close to the heart; but it must, I imagine, be limited to the area

Text-fig. 24.



Interior of right auricle of *Hippopotamus*.

a. Orifice of tributary of azygos (Az.). A.C. Anterior vena cava. B. Deep recess. *b.v.* Orifice of small blood-vessel. C. Coronary vein. P.C. Postcaval vein. *x*. Probe passed through auriculo-ventricular orifice.

marked P.C. in text-fig. 24. This corresponds with the position of the same vein in the Peccary. If this be so, the vein is actually

of less diameter than the azygos where both enter the heart. The letters *b.v.* in the text-figure indicate a depression in the wall of the auricle, which is here thick and muscular, as is also shown in the figure. Beyond this (*i. e.*, in the direction of the auriculo-ventricular valve) the wall becomes thin and white and very tough, suggesting the walls of a vein. This, however, can hardly belong really to the cut vena cava, the position of which would in that case become totally different to that of the Peccary. Beyond this point the walls of the auricle again become muscular, and a very sharp semicircular fold, as shown in the text-figure, marks the commencement of this muscular region. The fold is a little beyond (*i. e.*, towards the appendix auriculæ side) the entrance of the coronary vein. In the Peccary's heart the wall of the auricle is muscular for a much greater distance towards the orifice of the postcaval, and there is no membranous region, such as I have described above, opposite to the orifice of the coronary vein; indeed the muscular layer is seen to extend over about one-half of the flap which guards the orifice of the coronary vein. Nevertheless, beyond this point in the direction of the entrance of the postcaval the auricular wall is thin and membranous, *i. e.*, non-muscular. This fact gives me confidence in restricting the postcaval embouchure to the area lettered P.C. in the accompanying figure. It is therefore evidently a very small orifice relatively speaking. It may be seen also in the figure referred to (text-fig. 24, B) that the postcaval opens into an almost separate chamber of the auricle which is separated from the auricle itself by a high and broad ridge, beneath which, on the opposite side, lies the orifice of the coronary vein. Other than this there is no structure which can be termed an Eustachian valve. It will be seen in the figure that besides the pit in the auricular wall lettered *b.v.*, there are a few other and similar orifices scattered over the inside of the right auricle. These, which are not numerous, are to be regarded, I imagine, as the equivalents of the foramina Thebesii of human anatomists. I did not find the second precaval vein which Macalister has stated to be present in the dwarf Liberian Hippopotamus.

Through the kindness of Mr. R. H. Burne, I have been able to examine the heart of a Hippopotamus preserved in the Museum of the Royal College of Surgeons. The heart was a small one and obviously that of a fœtal or new-born animal, for the communication between the auricles was present, and the ductus Botalli was a wide vessel connecting the aorta and the pulmonary artery. I looked particularly at the relative sizes of the postcaval and precaval veins at their embouchure into the auricle; and although I am not able to give actual measurements, it was perfectly clear that both veins were roughly of the same size; in any case it is absolutely safe to say of this particular heart that the postcaval was not markedly smaller than the precaval. Gratiolet is very positive about the fact that in a young Hippopotamus which died about 24 hours after its birth, the postcaval

opened into the heart by a narrow canal, while the precaval opened "par un sinus enorme."

Dr. Chapman found in two Hippopotami, about five and a half feet long, that the precaval was "very large and readily transmitting blood to the heart, whereas the inferior cava, at least that part above the diaphragm, is rather small."

Dr. Crisp's statements are a little uncertain in their interpretation. He wrote that the "superior cava . . . is short, thin, and very capacious, measuring $1\frac{1}{4}$ inch in diameter. The inferior cava is also very capacious." The latter phrase might, however, refer to the postcaval below the diaphragm; otherwise it is obviously in direct contradiction to Chapman. In any case the specimen at the College of Surgeons Museum can be examined, and it will, I think, be found that my statement concerning it is correct.

The *coronary arteries* are very large. It is important, however, to mention that (as my colleague, Dr. Plimmer, points out to me) this is associated with degenerative changes in the muscle of the heart and mucoid degeneration of the visceral layer of the pericardium. Still a large size of these arteries seems to be found in other aquatic Mammalia *. They are not dealt with by Gratiolet †. In the heart examined by myself the arteries were two, arising on opposite sides of the aorta. The two coronary arteries differ in their size and distribution. That which is concerned with the blood-supply of the right ventricle is much the larger. This coronary passes with a sinuous course along the anterior edge of the ventricle, between it and the auricle. At the end of the right ventricle the artery bends downwards and runs along the inter-ventricular border, but as two arteries, for it divides near to the point of alteration of direction. Before this the branches of the coronary are inconspicuous.

The lesser coronary artery supplies the walls of the left ventricle. It passes straight from the aorta to the commencement of the ventricle; here it bifurcates into two arteries, of which the shorter (that which is to the right when the heart is viewed from the side of the left ventricle) runs down towards the apex of the ventricle along the border line of the left and right ventricles. The other branch runs similarly along the base of the left ventricle to the other side of the left ventricle, when it suddenly changes its direction and runs towards the apex of the heart, but at a considerable distance from the neighbouring branch of the other coronary artery. It does not reach the apex, at least not as so important a branch. It is evident from their course and relative importance that these arteries in *Hippopotamus* hardly differ from the coronary arteries of man.

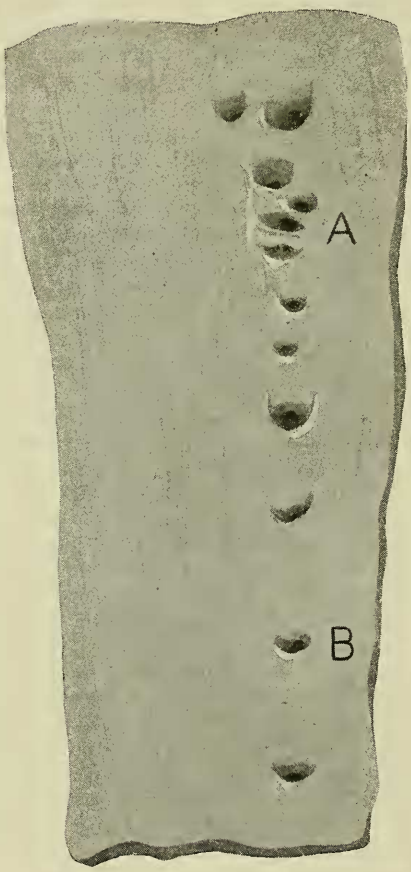
Among the arteries dealt with by Gratiolet we do not find any account of the *intercostals*. These I have represented in the

* *Cf.* Beddard, "Notes upon the Anatomy of a Manatee (*Manatus inunguis*)," P. Z. S. 1897, p. 52.

† *Loc. cit.* p. 361.

accompanying figure (text-fig. 25), which does not, however, show the complete series. In order to abbreviate the figure conveniently, only a certain number of the anterior arteries are shown; but nothing is lost by this omission, since after the point

Text-fig. 25.



Commencing aorta of *Hippopotamus* cut open to show orifices of intercostal arteries.

A. Cluster of intercostal and bronchial arteries. B. Series of regular intercostals.

at which the drawing ends the arteries have the same regular arrangement as in the latter part of that section of the aorta which is represented in the figure. The series commences with a pair of equisized apertures lying side by side. These are, I take

it, the mouths of origin of lung arteries. After a short gap there is a group of four arteries placed as is shown in the figure and crowded very close together. So close indeed, that the appearance of one artery with a cribriform plate at its aortic aperture is produced. Of the four, one or two are also lung arteries, as I ascertained by means of an inserted seeker. The others are intercostals. Then follow two arteries, one behind the other, which are placed rather more closely in sequence than those which follow. The latter form a series which are wider apart and perfectly regular until the end of the series, which, as already mentioned, is not shown in the drawing. It is to be noted, therefore, that the intercostals of this animal are quite unpaired at their origin from the aorta; the division occurs, however, shortly after the origin. The most important point of difference from the intercostal series of such other Mammals as I have had the opportunity of seeing, is in the mass of four arteries situated so close together at the beginning of the series, and which are lettered in the accompanying text-figure. The unpaired condition of the intercostals is perhaps rather less common among Mammals than a paired origin of these arteries. It is furthermore to be noted that there were no visible œsophageal arteries on the opposite side of the aorta in this region of that arterial trunk. Such arteries are commonly ventral instead of dorsal in position, and thus contrast with the intercostals and lung-arteries, which must be regarded as being one morphological series. It may be, however, that in the Hippopotamus the œsophageal arteries are derived from twigs of the intercostals; but as to this I have no positive information to offer.

The *azygos vein* is mentioned by Gratiolet only in the observation that "Les libres communications de l'azygos et des veines mammaires avec la veine cave supérieure indiquent que les muscles locomoteurs du tronc sont, ainsi que les centres nerveux, soustraits a toute case de congestion." In examining the thorax of the recently dead animal the apparent inconspicuousness of the azygos was striking. This was possibly due to the pleura of the thoracic wall being rather thick, but in other large animals such as the Zebra, where I have observed the azygos, it was perfectly obvious without further dissection, and I have figured it without difficulty in a number of Antelopes. So difficult to detect is this vein in *Hippopotamus*, that I had noted, before proceeding to dissection of the neighbouring parts, that the vein was absent as a distinct vein. I had in fact expected to meet with the conditions that appear to characterise the Cetacea, a state of affairs that would not perhaps have been unexpected. Nevertheless it does not occur, as I ascertained after the heart and lungs were removed, and therefore too late to give all the details desirable about this important vein in a type where it is likely to be interesting. I did, however, ascertain certain facts which are of importance in the systematic placing of this Ungulate. In the first place, there is a long azygos vein on the right side at any rate.

This is of itself important, because in the Artiodactyle Ungulates (with the exception only of the Tragulidæ—so far as we know at present) the main azygos is on the left side. There is, I believe, no other exception to this generalisation that has been described. In the second place, the azygos must lie very close to, in fact practically upon, the middle line of the centra of the dorsal vertebræ, for the cut ends of the intercostal trunks themselves lay very close indeed to this line, and I passed a probe up the intercostal vessel to its dorsal cut end, which was some way from the actual orifice into the azygos which, as already stated, had been removed. For some way along the ribs at any rate the intercostal veins were simple veins as in other Mammals, and there was no breaking up of the trunks into anything approaching the retia which Gratiolet has described in the case of the other veins.

In cutting away the aorta for further study the azygos was found to have been removed with it, and was firmly attached to the right side of the line along which the (at first sight) single intercostal arteries emerge from the aorta. It was, therefore, completely concealed when the various viscera were in position. It is obviously quite easy to determine upon which side of the aorta the azygos lay, since the intercostals must be supposed to emerge along the middle line, as they begin with single arteries which later divide into two branches, one for each side of the body. Judging in this way, the azygos of the Hippopotamus is a right azygos, and in this it agrees with *Tragulus* and differs from, at any rate, most of the Artiodactyles. It is very noteworthy that these two primitive genera should agree with each other and with the Perissodactyles and *Hyrax* *. It must, however, be recollected that *Cervus sika* has also a right azygos vein. I have already dealt with the opening of this vein into the right auricle †. The openings of its branches are very obvious, and have the same irregular arrangement anteriorly followed by a regular arrangement posteriorly, that we find in the case of the intercostal and other minor branches of the thoracic aorta. The first branch was a large one, about an inch from the auricular orifice of the vein. Behind this were two successive pairs of veins, of which one vein in each pair was rather larger than the other, and one vein of each pair was rather in advance of the other. Then followed a group of four inequisized venous orifices. At this point the azygos vein ceases from its close association with the aorta and passes straight to the right auricle, so that the veins hitherto considered belong (at any rate nearly all of them) to the visceral (œsophageal and pulmonary) affluents of the azygos. After this point come the regularly paired intercostals which lie on the ventral surface of the azygos just in front of the corresponding intercostal arteries.

* Beddard, "On the Azygos Vein of Mammals," P. Z. S. 1907, p. 181.
† *Suprà*, p. 226.